EPoSS.

European Association on Smart Systems Integration

EPoSS
Working Group Green ECS

Speaker: Daniela Iacopino

Content

- European Association on Smart Systems Integration (EPoSS) & Green Electronic Components and Systems (ECS) WG
- White paper
  - Global environmental context for Green ECS
  - Improving the current situation
  - Green ECS by design
  - Extending product lifetime
  - Summary & recommendations
- Authors

EPoSS.

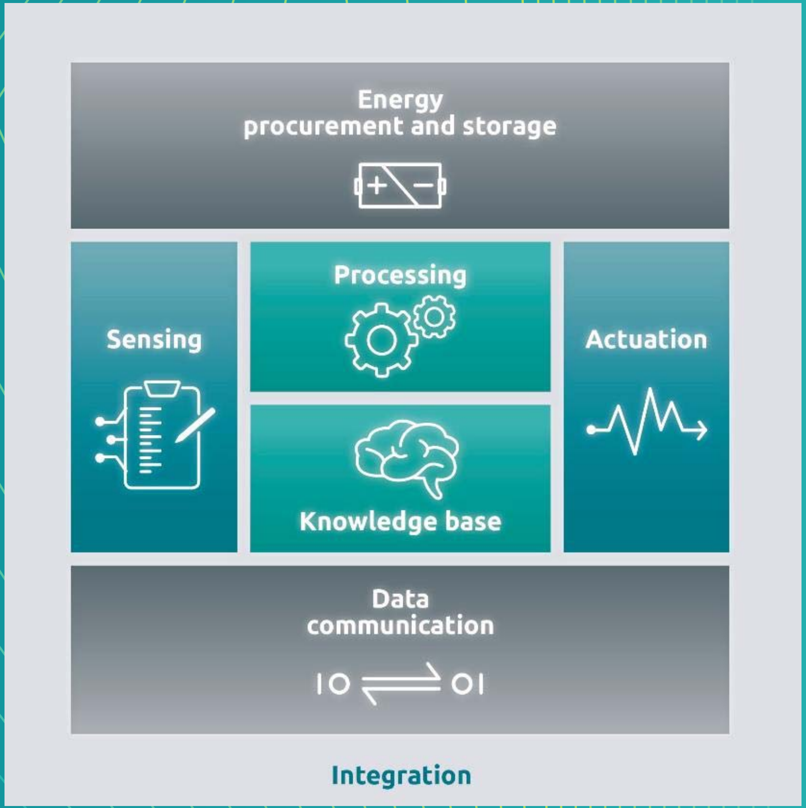
European Association on Smart Systems Integration

1. ADGENERA Innovation & technology
2. AIT Austrian Institute of Technology — Tomorrow Today
3. ARMENGAUD INNOVATE
4. AVL
5. BEEWEN AUTOMATION
6. Ben-Gurion University of the Negev
7. BOSCH Invented for life
8. B|BRAUN Sharing Expertise
9. CARTOGALICIA
10. cea
11. CNM
12. CERTH/HIT Hellenic Institute of Transport
13. ceus
14. Continental
15. csem
16. CTAG Centro Tecnológico de Automoción de Galicia
17. DATSA IDEA & IDA labs
18. elaphe Propulsion Technologies
19. elive ecosystem
20. esc Aerospace
21. EUROFORK
22. FLAG-MS
23. Flanders Make
24. Fraunhofer
25. GLOBETECH
26. Hahn Schickard
27. HITACHI Inspire the Next
28. i&m Ideas&Motion
29. I-FEVS
30. ikerlan
31. imec
32. IMM
33.
34. infineon
35. inivation
36. JAC
37. KATOTEK
38. KATAM
39. LEITAT managing technologies
40. Łukasiewicz
41. Meanwhile
42. mesap
43. muRata Innovator in Electronics
44. NovaPack Technologies
45. NXP
46. retuner
47. Orange Quantum Systems
48. METU MEMS Center
49. PUMACY
50. QRTECH
51. RISE
52. SAL Silicon Austria Labs
53. Sensative
54. sensry
55. SIEMENS Ingenuity for life
56. SINTEF
57. smart
58. Smart Greenery
59. ST life.augmented
60. TECNOLAB
61. Tyndall National Institute
62. USN University of South-Eastern Norway
63. VAISTO
64. vermon
65. ViNotion
66. VTT
67. YONGATEK

EPoSS Office

Smart Systems

- Assembly of technologies that build products from components
- provide safe and reliable operation under all relevant circumstances; and
- are as small as possible, networked and energy-autonomous.
- Need for a new ECOSYSTEM: education, research and development, product design, manufacture, business models and markets



European Context

- Research Priorities
- Roadmaps & SRA

EPoSS input

- Expert Knowledge
- Policy Approaches

KDT JU
KEY DIGITAL TECHNOLOGIES JOINT UNDERTAKING

Chips JU

CCAM
CONNECTED, COOPERATIVE & AUTOMATED MOBILITY

2ZERO

HealthTech4EU Alliance

TCI
TransContinuum Initiative

Horizon Europe
THE NEXT EU RESEARCH & INNOVATION PROGRAMME (2021 – 2027)
European Commission

Xecs

Alliances, common roadmaps, MoUs, aligned strategies, events, initiatives and networks

Working Groups and Task Forces I

Key Technologies	Green ECS	AI at the Edge	Transportation
• Materials and processes • Design methodologies and simulation • Reliability, safety and security • Advanced packaging • MEMS/ MOEMS • Integrated photonics • Actuators • Quantum technologies	• Global environmental context • Today: from cradle to gate • Green ECS by design. Future: from cradle to cradle • Extending product lifetime	• Neuromorphic Computing • Meta-learning • TinyML • Hybrid modeling • Federated Learning • Open source Hardware and Software • Energy and cost-efficient AI training at the Edge • Security, privacy, trustworthy and explainability	• Clean, efficient and electrified propulsion • Advanced Driver Assistance Systems (ADAS) • Connected and automated driving • Smart mobility services • ECS for hydrogen and battery control • Data science, AI and big data

Working Groups and Task Forces II

Healthy Living

- Smart systems for disease prevention and healthy lifestyles
- Personal medical devices
- Point of Care diagnostics
- Remote monitoring for chronic patients
- Improving the autonomy and integration of disabled and ageing people

Factory Automation

- Human-robot co-operation
- Autonomous self-determing robot systems
- Internet of Things
- Power management
- Machine-to-machine communication
- Architecture and modelling

Energy

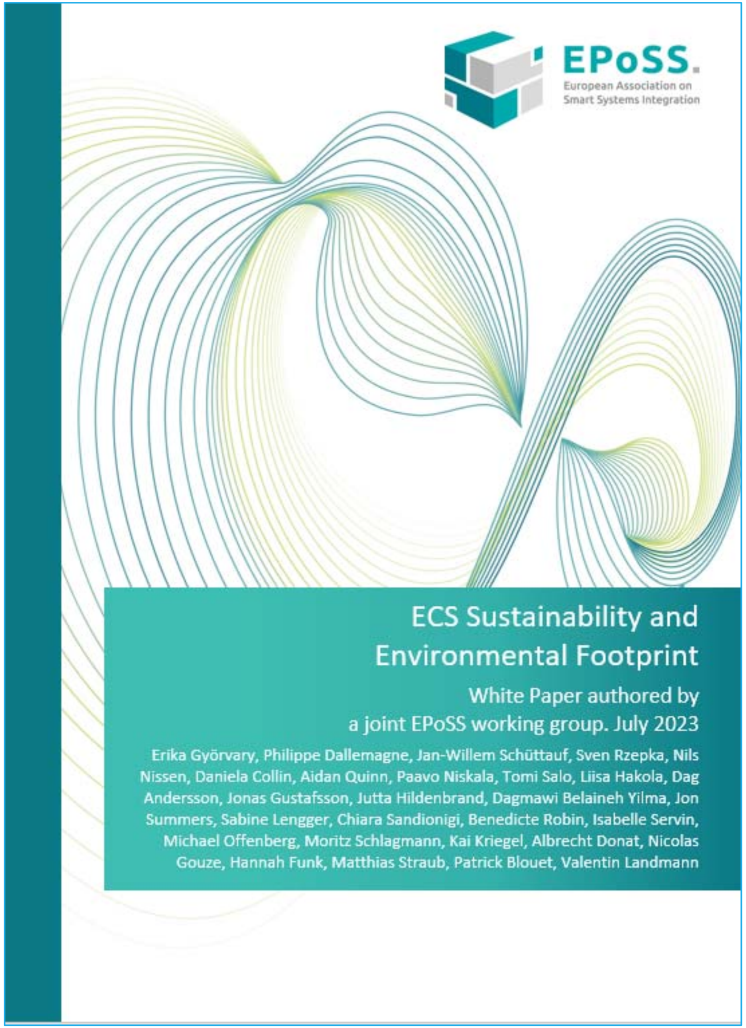
- Smart grid components
- Decentralised energy systems
- Energy efficiency
- Infrastructure monitoring
- Predictive energy management
- Power electronic actuators
- Inverter technology
- DC grids technology
- Energy for mobility

Food, Agricultures and Natural Resources

- Sustainable management
- Sustainable food production and consumption
- Environmental monitoring and remediation
- Animal and plant health

EPoSS: Green ECS Working Group

- Members: RTOs, SMEs, industries
- Join forces in sustainability & environmental impact topics
- Propose EU & KDT proposals for sustainability calls
- Propose focus topics for KDT
- Give inputs to Strategic Research and Innovation agenda (SRIA) for ECS
- Write white papers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ECS Sustainability and Environmental Footprint

White Paper authored by a joint EPoSS working group. July 2023

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EPoSS White Paper on Green ECS

ECS Sustainability and Environmental Footprint

- Published July 2023
- Open for consultation until 25 August 2023
- Finalised in September 2023

www.smart-systems-integration.org

Comments to contact@smart-systems-integration.org

EPoSS partners contributing to Green ECS

Materials
- Tyndall
- cnm
- Fraunhofer ISC
- SAL Silicon Austria Labs
- VTT

Processes
- cnm
- cea
- Fraunhofer IZM
- csem
- ST life.augmented
- VTT
- SAL Silicon Austria Labs
- Tyndall

Compo-nents
- cea
- csem
- ST life.augmented
- VTT
- Tyndall

Integra-tion
- Fraunhofer ENAS
- Fraunhofer IZM
- ST life.augmented
- RISE
- VTT
- cea

Reliabi-lity
- cea
- Fraunhofer IZM
- Fraunhofer ENAS
- RISE
- ST life.augmented

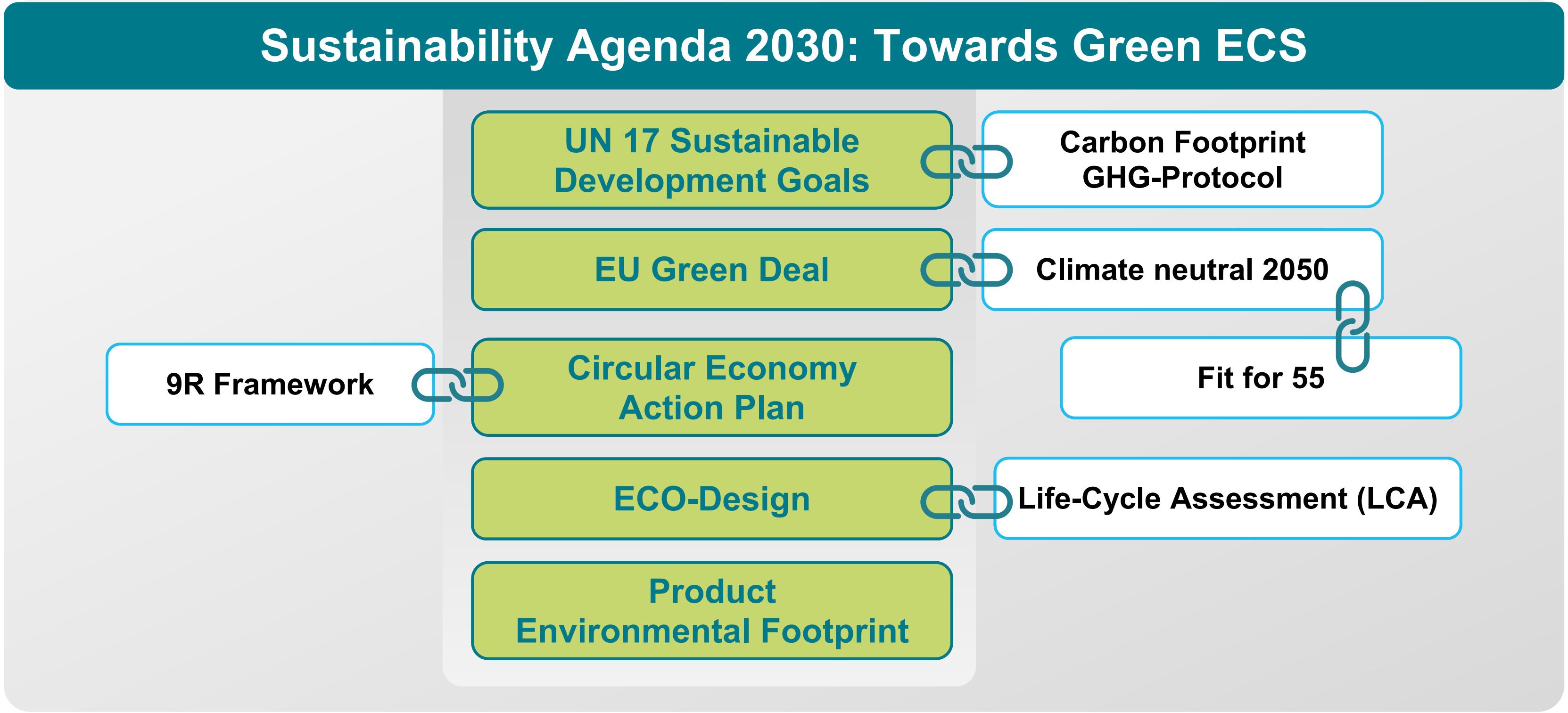
Eco-Design
- cea
- cnm
- Fraunhofer IZM
- csem
- SAL Silicon Austria Labs
- RISE
- ST life.augmented
- VTT

Software
- csem

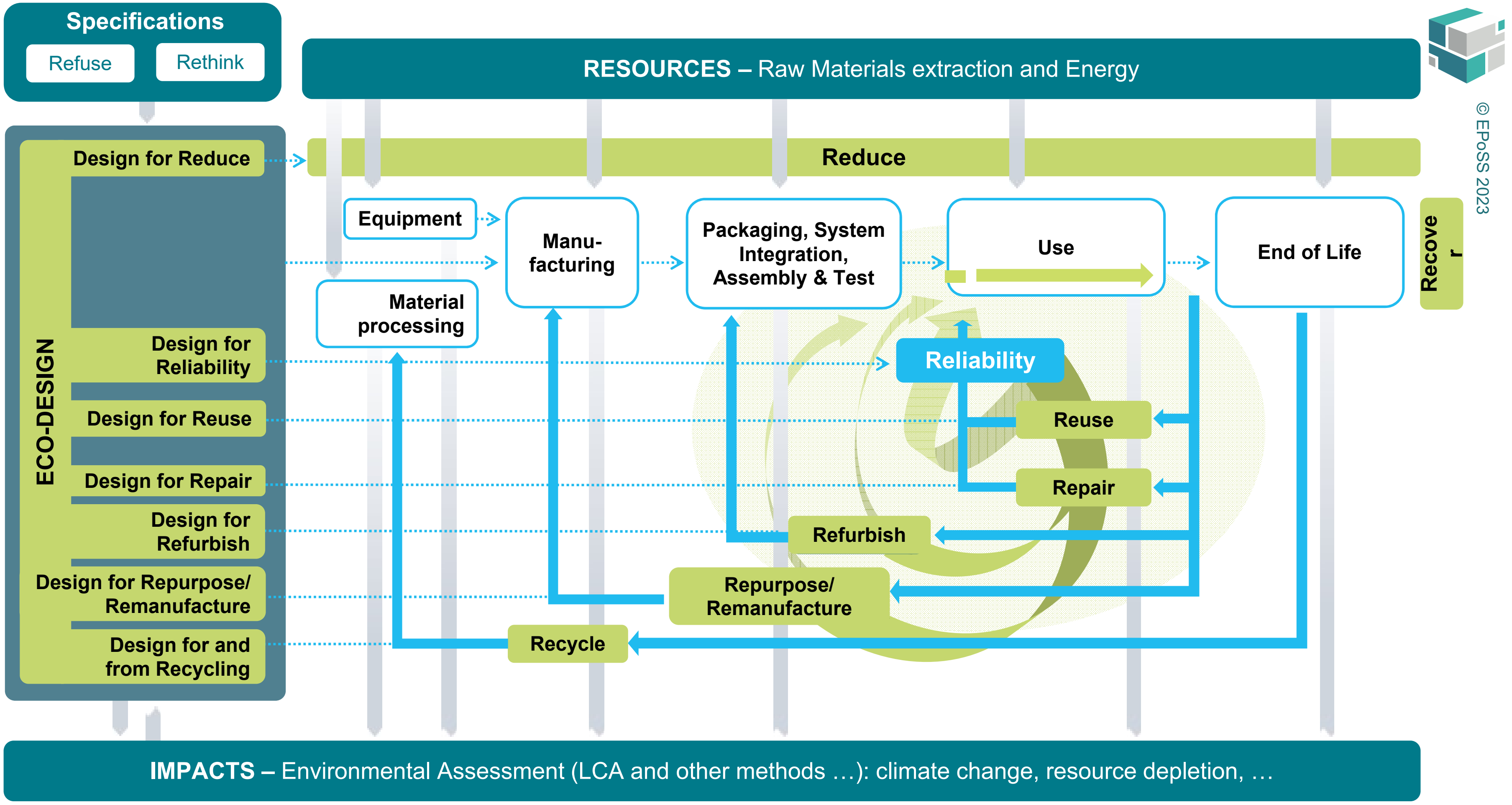
Repair
- SIEMENS
- infineon
- BOSCH

Standards & regulations
- microTEC Südwest

From the Agenda 2030 to Green ECS

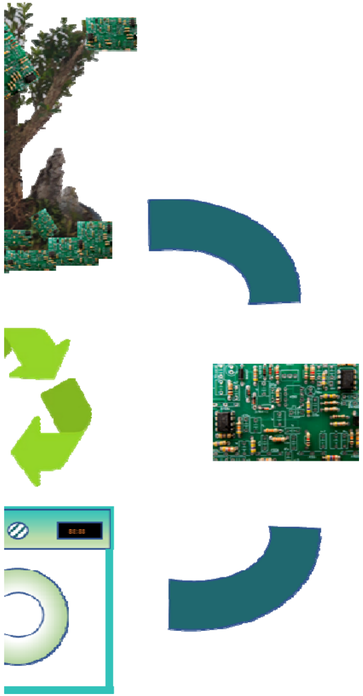


Overview of Sustainability Regulations and Standards



Design for R concept applied to ECS circular economy (B. Robin, CEA)

Today's cradle to gate is not yet circular.



It is obvious through our global waste issue from electrical and electronic equipment (WEEE or also called E-waste).

Source: microTEC Südwest e.V.

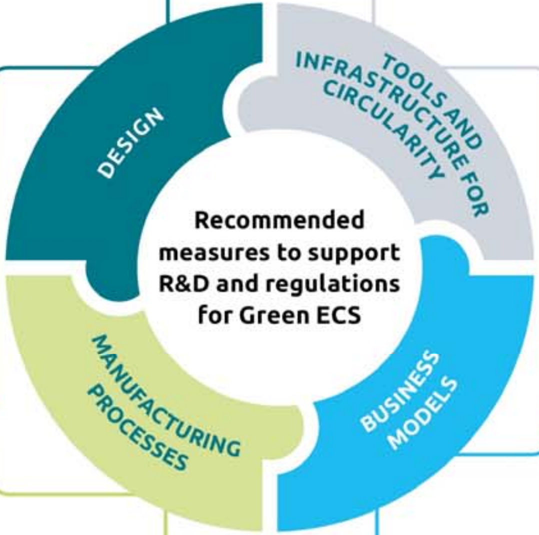
How can Green ECS support a cradle to cradle approach?

Source: microTEC Südwest e.V.

Recommendations

Design:

- Identify, reduce or replace all harzardous materials (e.g. PFAS).
- Reduce and replace rare, valuable and critical materials, e.g. with renewable or bio-based ones.
- Promote eco-reliabilty for an extended lifetime, smaller environmental footprint and higher material efficiency.
- Perform more LCA and PEF, relevant life cycle and environmental footprint assessments to gain more certified up-to-date data for PCR and EPD.
- Increase modularity and separability without sacrificing performance.
- Motivate and generously reward any kind of radical green innovations and new environmentally friendly focused technologies.
- EU ecodesign legislation must establish clear benchmark values for i.e. 9Rs. Specific effort is needed for electronic components that are only indirectly addressed through product group measures.



Tools and Infrastructure for Circularity:

- Prioritise the 9R framework to speed up the capabilities of industry to comply with eco-design regulations.
- Increase data and data transparency of complete supply and value chains, e.g. through digital product passports.
- Increase the security of AI and software to ensure a sustainable digital ecosystem of ECS.
- Reduce short lifetime devices.
- Establish a collaboration platform for eco-designers, manufacturers & recyclers, which is urgently needed to coordinate and speed up the greening of ECS.
- Further promote awareness and education on sustainability for all stakeholders.

Manufacturing Processes:

- Use renewable and bio-based materials through additive methods.
- Use robotics to increase efficiency and to create new value streams to speed up the capabilities of industry to comply with e-waste recyclability.

Business Models:

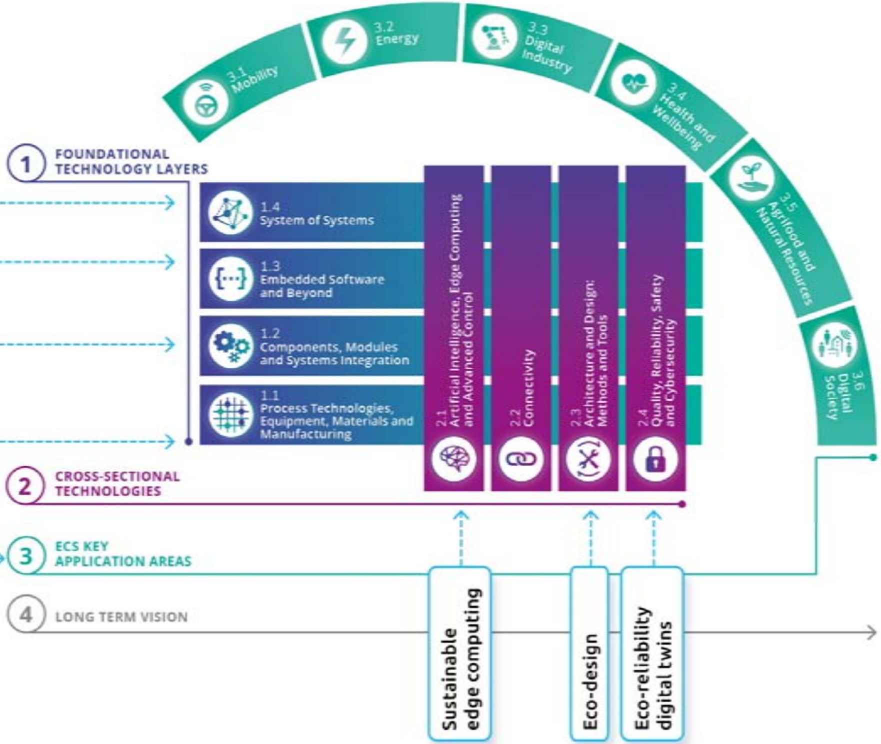
- Increase repair rates, e.g. through bonus–malus systems because cost of repair is still an inhibitor.
- Establish a repair index inspired by the French repairability index.

The challenges for R&D and regulation for green ECS and a successful reduction of e-waste identified by the EPoSS expert group

Counter check the ECS-SRIA roadmap 2023

White Paper recommendations

- Circular Infrastructure
- SW supported sustainable inter-connected digitalized ecosystem
- ULP components, Energy harvesting
  Recyclability, Eco-design
  Reliable LCA, Circular economy principles
- Eliminating hazardous materials
  Reducing energy & water consumption
  Sustainable manufacturing methods
- Business models incl. eco-design & recyclability and value repairability, sustainable value chains



Additional actions for sustainable ECS and e-waste reduction to the ECS-SRIA Roadmap 2023

	2023	2027	2032	long term

1.1 Process Technology, Equipment, Materials & Manufacturing

Major Challenge 2
Novel devices and circuits that enable advanced functionality with novel sustainable processes (additive methods)

2.5: Flexible and structural substrates electronics

2023	2027	2032
• Bio-based feedstocks	• Novel chemistry-based release concepts for better recyclability • Highly recycled content of bio-degradable materials	• Reliable devices based on low environmental impact materials, incl. easy recyclability • Zero waste added manufacturing to produce functional modules (mix of printed substrate, printed components, and conventional components integrated in build-up processes)

Major Challenge 3
Advanced heterogeneous Integration & packaging

3.4 Enhance reliability, robustness and sustainable technologies

2023	2027	2032
• Less material for higher functionality • Material and energy saving through heterogeneous integration (high performance and high flexibility packaging) • Enhance testing of separate components, before assembly via concepts such as KGD, BIST and self-repair	• Recycled content and novel materials in high-end and low-end applications, i.e. including solutions for one-time-use products	• Highly integrated re-usable circuit blocks, such as «universal computer modules»

Major Challenge 4
World-leading and sustainable semiconductor manufacturing equipment and technologies

4.5 Sustainable semiconductor manufacturing

2023	2027	2032
• Solvents with low env. impact • Water-soluble bio-sourced process chemicals • PFAS-free product alternatives	• Energy-efficient ventilation • Process steps with low env. impact • Safe and sustainable by design chemicals and materials • Critical raw materials reduction • Solvent management and recycling	• Energy-efficient tooling • Safe and sustainable by design chemicals and materials • Limit use of scarce semiconductor elements to functional layers (not bulk wafers)

1.2 Components, Modules, System Integration

Major Challenge 1
Enabling new functionalities in components with More-than-Moore technologies

1.6: Energy and thermal management

2023	2027	2032
• Lightweight energy harvesters and storage	• Advanced encapsulation materials for energy harvesters • Extend chiplet concept (design and manufacturing) to non-IC components • Sensors and actuators for the optimisation of battery cells usage during their entire lifetime	

Major Challenge 3
Sustainability and recyclability

3.1 Sustainable integration and use of ECS

2023	2027	2032
• Less material for higher functionality • Availability and exchangeability of spare parts and tools • Certified up-to-date data for LCA, PEF, PCR and EDP • Eco-design benchmark values for electronic components • Establish a repair index inspired by the French repairability index	• Cross-company reuse of "stable" chip designs, including More-than-Moore components (above) • Repair as business (bonus-malus-systems) • A business model can emerge for third-party repair centres	• Environmental footprint and criticality based recycling planning (final stage material recycling) • Set up repair process: – Failure characterisation, repair and re-characterisation – Provide manuals, instructions, schematics, and inexpensive spare parts – Train skilled repairers – Questions around re-certification, warranties and safety-relevance need to be addressed

3.2: Recyclability of components, modules and systems

2023	2027	2032
	• Closing data gaps incircularity and recycling through Digital Product Passport	

2.4 Quality, reliability, safety and cybersecurity

Major Challenge 1
Ensuring HW quality and reliability

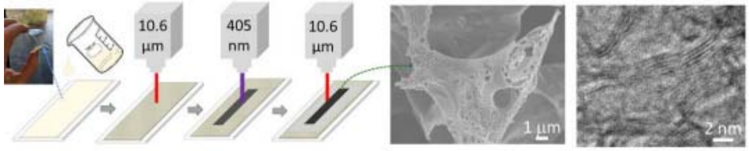
1.2: Reliability: tests and modelling

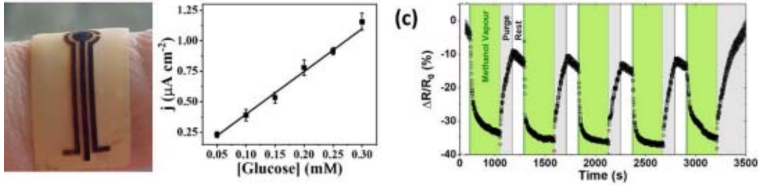
2023	2027	2032
	• Overhaul of conventional testing in development and qualification tests (in combination with virtual qualification)	

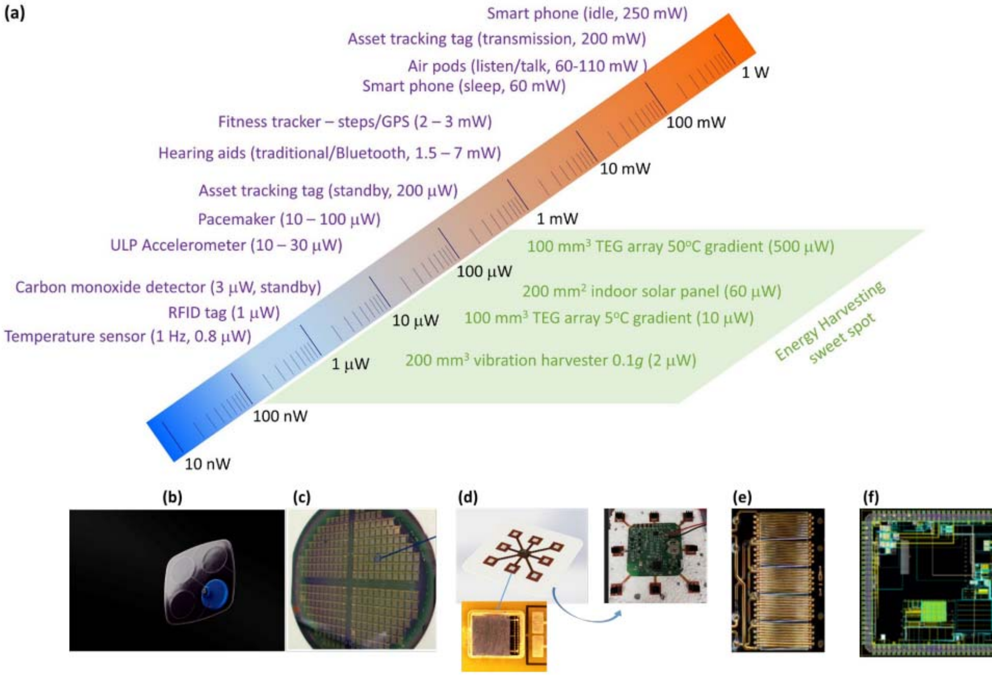
Tyndall Contribution

Power consumption for IoT edge devices during operation, communication, standby and sleep modes. “sweet spot” for energy harvesting (100 nW – 0.5 mW)

Sensing components







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- Patrick Blouet, ST
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Thank you
for your kind attention.

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